

Activity Title: Exploring the Role of a Fishery Scientist

Subject (Focus/Topic): Scientific methodology

Grade Level: High school

Average Learning Time: One 50 min class period

Lesson Summary (Overview/Purpose): Students will read the Log/journal entries written by a Teacher at Sea alumni to learn about the role of a fishery scientist.

Overall Concept (Big Idea/Essential Question): How are fisheries managed and protected?

- **How do scientists study fisheries?**
-

Focus Questions (Specific Questions):

- How do scientists decide where to sample?
- Under what conditions will a fishery be closed?
- What sources of error did scientists wonder about in their data collection? What steps did the scientists take to limit sources of error? How reliable is the data they collect?
- Describe the work of a marine scientist on an expedition like this. What characteristics are important for them to have? If you wanted to be a fisheries scientist what would be some things to consider when thinking about topics to study in college?
- What was the most surprising thing that you learn while reading Julianne' Log? What did you find the most interesting?

Objectives/Learning Goals:

For students to have a greater understanding of how fisheries are managed and protected.

- **For students to have an understanding of the methodology used by scientists during their data collection**
- **For students to have an understanding of the training and expertise needed to study fisheries**

Materials: Student journals, handouts of the Teacher at Sea logs

Keywords: fishery, fishery scientist, open and closed areas

Pre-Assessment Strategy-students will answer the following questions in their journal before reading the teacher logs:

- What is a fishery?
- How are populations in the ocean monitored? Who collects this information? What is their training?
- How is determining the population sizes of aquatic species different than tracking populations on land?
- Are there laws/regulations in place for how many of a particular species can be fished? Who determines these laws/regulations? How are they enforced?
- How are scallops harvested? Why are scallops important?
- Once you have finished answering the questions, share your answers with the person sitting next to you. Do you have a similar knowledge base?

Lesson Procedure: See below

Standards:

- **National Science Education Standard(s) Addressed: 1.1. Students will demonstrate an increasing understanding of how the scientific enterprise operates**
 - **Ocean Literacy Principles Addressed:** The oceans and humans are inextricably interconnected.
 - Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution and physical modifications. In addition, humans have removed most of the large vertebrates from the ocean.

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Creation date: April 2011

Goals:

- **For students to have a greater understanding of how fisheries are managed and protected.**
- **For students to have an understanding of the methodology used by scientists during their data collection**
- **For students to have an understanding of the training and expertise needed to study fisheries**

1. Start class with a pre-assessment to determine what students know about managing fisheries:

Pre-Assessment (have students answer the following questions in there journal)

- What is a fishery?
- How are populations in the ocean monitored? Who collects this information? What is their training?
- How is determining the population sizes of aquatic species different than tracking populations on land?
- Are there laws/regulations in place for how many of a particular species can be fished? Who determines these laws/regulations? How are they enforced?
- How are scallops harvested? Why are scallops important?
- Once you have finished answering the questions, share your answers with the person sitting next to you. Do you have a similar knowledge base?

2. Have students read Julianne's Log Entries from her time on the Sharp and answer the following questions in your journal.

- How do scientists decide where to sample? (Log 2)
- Under what conditions will a fishery be closed? (Log 2)

- What sources of error did scientists wonder about in their data collection? What steps did the scientists take to limit sources of error? How reliable is the data they collect? (Log 4)
- What kinds of recommendations can scientists make to local and state governments to maintain healthy fish populations? (Log 2)
- Describe the work of a marine scientist on an expedition like this. What characteristics are important for them to have? If you wanted to be a fisheries scientist what would be some things to consider when thinking about topics to study in college?(Log 6)
- What was the most surprising thing that you learn while reading Julianne' Log? What did you find the most interesting?

3. At the end of class, whole class discussion:

- Review the answers to the pre-assessment questions. What do students now understand that they didn't before?
- What did you learn about how fisheries are managed? What is involved with this process?

Log 1

NOAA Ship *Hugh R. Sharp*

Mission: Sea Scallop Survey

Geographical area of cruise: Lewes, Delaware

Date: May 10-11, 2010

Weather Data from the Bridge

Overcast, rainy, in the 50s

Science and Technology Log

I am about to spend my first night aboard a boat! I arrived to Lewes, Delaware this afternoon and the driver took me to the University of Delaware's Marine Program campus. From the distance I could see the top deck of the *Hugh R Sharp*. It was much bigger than I had expected (147 ft) and I was surprised by all of the heavy equipment used for lifting and hauling the dredges, different storage vans for extra space, freezers, and lots of computers, monitors, wires, etc. I met the chief scientist of our survey cruise, Victor Nordahl of the National Oceans and Atmospheric Administration, who spent some time explaining to me a little about the purpose of our mission for the next two weeks.

Why scallops? This was a question that I had when I learned that I would be a part of this expedition. After some internet searching I found a tremendous amount of data on scallops and learned that many survey cruises like this one take place. I love my marine invertebrates just as much as the next person (alright, probably a whole lot more!) but it seemed like a lot of energy invested in monitoring their population size. It turns out that it boils down to money; scallops are a \$450 million resource! Scallops are one of the most important fisheries in the Northeast United States. It is essential that this economic resource is harvested responsibly so that their populations are sustainable. NOAA's annual sea scallop dredges occur in three legs to carefully monitor the scallop populations, sampling areas as far south as Virginia and as far north as Georges Bank. NOAA's responsibility is to take an accurate inventory of the scallops, their size and age. Based on their sizes and ages NOAA scientists can use computer models to make predictions for the future of the population in an area. This information can get passed on to a regional council. The council then makes recommendations/regulations for the scallop fishing industry. These regulations are around the minimum size of the catch, the number of boats, the number of crew members on the boat and the number of days that fishing is permitted.

Before I left school, I asked my students what questions they had about my expedition. They had tons about scallop life history, data collection methods, life aboard a ship, human impact on the ocean and about some of the other sea life we might see while at sea. I will be trying to answer many of those questions in this log. Maddie K. asked the question, "Who eats scallops aside from people?" One species that I learned today that likes to eat scallop larvae are sea stars. During some of our dredges we will also inventory sea stars and crabs so that we can also monitor the population sizes of the scallop predators. This information provides the scientists with important clues on the future of the scallop population in an area. If there are a lot of predators then there might not be a lot of scallops in the future. I am looking forward to pulling up lots of sea stars in the nets. I bet we will pick up some big ones and I wonder which species we'll find. The chief scientist says that the stars and crabs are pretty hardy and usually survive the dredge without a problem. Liz B. asked if the animals are released after they have been inventoried and it sounds like most everything is tossed back overboard after it has been weighed and inventoried. I am very much looking forward to seeing what comes up in our first dredge!

Personal Log

One thing that has been cool is the people that I have met. It is funny since we are in Delaware I wasn't expecting to have many connections with the people on board. But it is a small world! There is someone on board who was a judge at this year's Ocean Bowl competition—of course I had to describe to him our team's amazing second place finish. There is a cadet from the Coast Guard who played lacrosse against Souhegan and was friends with some former

students. And then many people are from Woods Hole and Falmouth on the Cape, which is where I always spend lots of time in the summer.

We are heading out this afternoon with the tide around 5:30. I can't wait to get out on the open ocean. Far in the distance, I can see many boats passing by—and some are huge tankers. I look forward to going up to the bow and taking it all in. Fun adventure ahead for tonight, once we get underway we will do some practice sampling and then it is about a 4.5 hour cruise to our first station.

Atlantic Deep Sea Scallop

Phylum: Mollusca

Class: Bivalvia

Species: *Placopectin magellanicus*

Physical description: large (2-8"), circular. Since it is a bivalve it has two shells (or valves). When reading about scallops in the [Audubon Society Field Guide to North American Seashells](#), something interesting that I learned is that the two shells differ in color. The exterior of the right valve is usually dirty white while the left valve is reddish or pinkish. I am wondering how they determine which is right and which is left? Inside the scallop is a large adductor muscle. This muscle allows the scallop to open and close and it is the part you eat (if you like scallops!)

Feeding: Scallops are filter feeders who enjoy their phytoplankton.

Predator/Prey relationships: One of the coolest things about scallops is that they can swim! They force water out of their shell and move right along in the water column. The purpose of this is to be able to scoot away from their biggest predators—sea stars!

Habitat: on sand or rubble, water 60-400' deep

Range: Canada to North Carolina

Log 2

NOAA Ship *Hugh R. Sharp*

Mission: Sea Scallop Survey

Geographical area of cruise: Lewes, Delaware

Date: May 11, 2010

Weather Data from the Bridge

Overcast, rainy, in the 50s

Science and Technology Log-Data Collection/Sampling Methodology

For NOAA's scallop survey, it is divided into three different legs or cruises, each sampling a different area along the east coast. This cruise that I am on is the first in the series. During this time, since we will be working around the clock, we will probably do somewhere between 150-200 dredges and the NOAA team will sample about 500 total for the season. But how do scientists determine where to dredge? How can they be sure that the sites that are sampled will give them an accurate representation of the number of scallops on the sea floor?

To determine where to sample, scientists use the Stratified Random Sampling Design. This is the method for determining the average number of an animal in a given area. This sampling technique is based on the fact that the scallop population density depends on the ocean depth. Scallops like to hang out in 50-100 m of water. Scientists break up the coastline that they're studying into different "strata" or quadrants. And then instead of a totally random sample in a given area, the stratified random sampling design uses a computer to select more collection sites in the depths where you would be likely to find the most scallops, since that is what scientists are interested in.

Scallop Fisheries

The scallop fishery is an economically important fishery, maybe second only to the lobster industry in the Atlantic. One question that one of my students asked was, "Is the scallop population growing or is it in danger?" I asked our chief scientist that question this afternoon. His response was very promising, that the scallops are doing very well. Part of the reason for their success is due to the regulations that are set in place, the same regulations that are based on the data collected by this trip. One type of regulation that has been helpful is the temporary closure of certain areas. These closures give scallops in a particular area a chance to grow. So if during a scallop survey cruise, scientists notice a lot of young scallops in a given area, that data will get reported and maybe lead to the temporary closure, meaning that you can't fish for scallops there for a couple of seasons. Then after some time for the animals to grow, the area will be reopened. By rotating these closed areas, it allows the time necessary for population growth.

Astrid B. asked the following question, "Does the dredge hurt the ocean bottom?" Our dredge is fairly small, about eight feet across. But a commercial fishing boat has two dredges that are about 15 feet wide that go down at the same time. And at a given time, there might be as many as 500 boats out fishing for scallops. Before and after photographs have shown that the dredges do impact the bottom. It works to flatten everything in its path, including living organisms. It also affects an important habitat. Fish species like cod like to hang out around the nooks and crannies that are created by benthic creatures, but without that important living structure, the cod population doesn't have the habitat it prefers (which may be an explanation for why that population has been slow to recover). While more research needs to be done to find out how long it takes for the substrate to recover and return to its pre-dredge state, dredging does have some pretty clear impacts on the sea floor habitat.

Brandon O had a fun question, "What is the funniest thing that got brought up by the dredge?" The chief scientist said that once they brought up pieces of an airplane in a dredge. I asked if it hurt the dredge and it didn't because the plane was made of light aluminum. And then he said that they have also found mammoth teeth. That is very cool! A long time ago this whole area was not covered by water, but instead it was land for woolly mammoths to walk over. I think this is especially neat after just seeing lots of skeletons of mammoths at the Natural History Museum during our trip to New York City over vacation. I can't wait to find out what will be the most interesting thing we'll find during this trip!

Personal Log

We just officially set out to sea! It was a long day waiting for all the preparations to be finalized and for the water to be high enough so we could leave port. It is a chilly day, with the wind blowing on the ocean and a little drizzle coming down—but so exciting to be moving and heading out! Lots of students had many questions for me about food, especially considering my mantra, “Fish are friends, not food.” So far so good, lots of chicken, pasta and the most unbelievable snack cabinet—featuring all sorts of goodies that we never keep at home (Oreos, cheese-its, candy bars, soda). And then today, I saw for the first time--the ice cream freezer. And entire freezer, dedicated to the storage of frozen treats—what a beautiful concept! As it turns out, there used to be a treadmill on the boat, but they had to move it off to make room for the ice cream. I like where their priorities are and it is clear that I won’t be going hungry!

Log 3

University of Delaware R/V *Hugh R. Sharp*

Mission: Sea Scallop Survey: Leg III

Port of Departure: Lewes, Delaware

Location: Off the coast of Virginia

Date: May 12, 2010

Weather Data from the Bridge

Air temp: 13.72°C, 85% humidity, overcast

Science and Technology Log

When the dredge gets pulled up the ramp of the ship, I always strain to try to see past the chain and netting to see what amazing creatures might have gotten caught in the dredge. I can see the pale-as-a-ghost face on the underside of skates and flounders. The sea stars fall to the table in a big mound and you can see the crabs trying to climb the net. And of course the scallops! They get dumped out onto the table in a wave. The pile of creatures undulates as organisms try to right themselves and seek cover. Each dredge so far has been different. Some are chock full of sea stars such as *Asterias forbesii* and *Asterias vulgaris* which we have at home, but by far the most abundant sea star species is *Astropectin* sp. There was one dredge that was all sand dollars and they tumbled out onto the deck, like hundreds of poker chips, hockey pucks and small frisbees. I noticed that all of the fish in the dredge were green and then everything else started turning green. Apparently, sand dollars turn everything green! No one was quite sure why—this will be something to investigate once I get home.

So you can imagine how exciting it is to see hundreds (in some cases maybe thousands) of your sea friends, dumped out in front of you to examine! I think about all the hours toiling at Odiorne Point with my students searching under rocks and peeling back algae in the intertidal zone looking for a hidden gem. Here on the sorting table at the back of the boat there are so many species, so many things waiting to be discovered. I think about my marine biologists at home and how excited they would be to have some of these critters for our tank! (And while the thought has crossed my mind to try to kidnap some, that might be a difficult situation to explain going through security at the airport—a cooler full of crabs, sand dollars, sea stars and scallops!) The object here is not to study all the cool creatures for hours under a microscope which is what I would love to do (there isn't even a microscope on the ship!) but instead, to sort. My job, with 5 other people, is pull out all the scallops and fish. Those get measured and counted and everything else goes back into the water. It all happens very quickly. Because the goal is to do so many dredges in a relatively short amount of time, the faster you process everything the faster we can move on to our next sampling location, which means the more data that can be collected. Also time is money on this high tech ship we are on. For the scientists to use the R/V *Hugh R. Sharp* it costs \$12,000 a day. So it is imperative to work quickly to get the job done. But I am learning some tricks so that I can spend a little more time with the creatures I really want to check out. I usually sneak a couple of neat things to photograph off to the side and after we are finished with the work at hand take a few minutes to study them. And the scientists have figured out that when they have an organism that we haven't seen yet, they have to show it to me before it gets tossed back overboard!

We were just pulling up a dredge last night when Ben pointed to the starboard side of the ship. There in the starlight were about eight dolphins riding in the wake of the boat. They were porpoising in and out of the water. They were gray, with speckled black dots; I think they were Atlantic Spotted Dolphins. It was the first night that we could see stars, other than the sea star variety. I thought of Kat S. who was the first person who got me excited about the prospect of seeing stars at night from the boat. Between the starlight and the spotlights on the ship, the sea below sparkled. Even in the dark water you could see the water shimmer and change to a light green color, letting you know where the

dolphins were just before they surfaced. I have a list of top wildlife encounters in my life (swimming with whale sharks and eagle rays, saving stranded pilot whales in the keys, viewing humpbacks breach in a storm in the Bay of Fundy, nesting sea turtles Mexico, watching baby orcas play in the San Juan Islands, etc) but even with this list, watching the dolphins at night beneath the stars was pretty magical!

Captain Bill nonchalantly mentioned that he had seen an ocean sunfish (*Mola mola*) yesterday morning. “What?!” I guess I hadn’t made it clear that I wanted to witness any such animal encounters. I had told my students that the ocean sunfish was the one species I was really looking forward to seeing on this trip. I had seen them in various aquariums but never in the wild. The ocean sunfish has always seemed to me a freak of natural selection. How could something so big, clumsy and awkward looking have survived evolution? Something about the way it lazes around without a care in the world has always appealed to me. This morning, I took my usual watch on the bow of the boat (as I do every morning before my watch begins at 12:00). There, about 50 ft from the boat, I saw two large fins, flopping this way and that without an apparent purpose. It was *Mola mola*! We didn’t get very close and our boat was traveling fast but through my binos I at least got a glimpse of its round, disc body. And a couple of hours later, I saw another—this one a little further away. So I know there are lots out there—now the goal is to get an up-close view and hopefully a photo!

Personal Log

It is pretty awesome now that the weather is brightening and we are seeing some beautiful species! I love being on the top decks watching the sunlight dance on the water. I love that everywhere I look all I see is ocean. Yesterday we saw many other ships on the water—but today it is really just us steaming along. At first it was a little hard to get used to seeing lots of dead fish in the dredge and lots of animals that don’t survive the sampling. There is a lot more bycatch than I would have expected. It is going to take a little more time for me to process my thoughts about it all, but I am starting to understand that for now this is the best way for the data to be collected. While it might not be the best thing for individual organisms, these sampling techniques are important for protecting the fisheries and ultimately the ecosystem.

Log 4

University of Delaware R/V *Hugh R. Sharp*

Mission: Sea Scallop Survey: Leg III

Port of Departure: Lewes, Delaware

Location: Off the coast of Maryland

Date: May 15, 2010

Weather Data from the Bridge

Air temp: 16.6°C, clear skies, 10% cloud cover

Water conditions

SST: 13.16°C, Salinity: 31.7ppt

Science and Technology Log

Got sea stars?

We have pulled up some impressive loads of scallops so far on this trip! Our largest load included 2,083 scallops (which is about 750 lbs). When they come up in the dredge you can hear them coming. They clatter in the net as they get hauled out and dumped out onto the deck. But even when we are so tired of counting the scallops and lifting the heavy baskets, the scientists and crew members have said, "Just wait! You haven't seen anything yet!" referencing the fact that there were many more scallops to come.

But today, in a location where in years past have been home to a large numbers of scallops, we didn't find many. In fact at our last station, there were only five. Instead, the net bulges with the sea star, *Astropectin*. "Where are all the scallops?" is a question that the scientists keep asking themselves because this data is so surprising to them. Today we passed many fishing boats, in fact at one point there were at least five on the horizon surrounding us. I had thought that was an important clue that meant we were bound to find lots shellfish, but that hasn't been the case. Because this data is surprising, it has the scientists asking another question "Is there a problem with the collection gear?" Fortunately, there are many systems set in place to guarantee that everything is working properly.

During experiments at school, we try to make sure that students know to standardize the procedure and limit variables so that they can be sure the results they attain are based on the one variable they isolated and not due to some other environmental factor. That principle couldn't be more true on this scallop survey. It is of the utmost importance that all the data that is collected, is collected the same way at each location, and as it was collected in previous years. For this reason, all the specifications about the dredge (the size of the dredge, the size of the rings that let small organisms out, but trap the larger organisms) are kept the same throughout each leg of the survey and each year. In addition to this, they also measure the angle of the dredge with an inclinometer. This way they can make sure that the dredge is always in the same position as it moves along the seafloor. The tow is always for the same length of time, going at the same speed, and going in a straight line. You can see that if a tow was down for a longer amount of time that would change the amount of organisms being caught. To double check all of these procedures, we mounted a camera on to the dredge. This camera had a timer on it as well. It was really fun to watch the video; the dredge fell through the water column and then settled on the sea floor in a puff of mud. The dredge sped along the substrate and we could see little sea stars falling back into the net. Watching the footage, the scientists were able to double check that the angle on the dredge and the amount of time it spent on the bottom was consistent with the measurements they were getting from the inclinometer. Since this data is helping to manage such a valuable economic resource, the scientists need to be extremely confident in the data collection methods. Using this data, decisions will be made about the fishing regulations in the area which ultimately impacts people's jobs and income.

Because these scientists have carefully and deliberately eliminated so many variables they can be sure that their equipment is working properly and that they can trust their data. But that still leaves the question, where are they scallops? Have all of the scallop fishing boats that we can see in the distance totally wiped this area clean? Or is it to do with the incredible numbers of sea stars that we have seen, gorging themselves on their favorite delicacy? Hopefully, this particular region is isolated and we will have been luck finding scallops tomorrow.

Jack C's question was, "Did you catch any sharks?" And yes we have! We have caught a bunch of a small type of shark called a chain dogfish. They have a very cool pattern on their skin that looks like a chain link fence and they are usually around a foot or so long. We also caught a shark that was a little bigger called a smooth dogfish. What is great about these guys is that they are a little more resilient than some of the other fish that we catch. They make it back to the water without a problem and we watch them swim away.

My patrol of the bow of the boat certainly paid off today. I saw so many dolphins! The past couple of days I have been in awe of the handful of dolphins we have seen and by the sunfish. But, honestly, I was a little surprised that we hadn't seen more mammals. Well, the dolphins found us today! On and off today, dolphins would stop by the boat for a few minutes to play in the wake or up near the bow. They would leap and splash a couple of times and then be on their way. It was a different species than the dolphins that had visited us at night—these were grey on the top, then a tan color on the sides and white underneath, which I determined to be the Common Dolphin. This afternoon a couple were near the back of the boat when we had a break between hauls. Knowing that the dolphins especially like to play near the bow of the boat, I went to see if maybe some of their friends were up front. Sure enough, surging through the water, weaving between each other were at least a dozen dolphins. Then I happened to look up—and there coming towards the boat were even more dolphins. They were porpoising through the water coming from ahead of the boat. You could see them coming from at least a ½ mile away by the repetitive, white splash of the water. It was like a dolphin convention was happening at the *Sharp*! They would meet each other at the bow and enjoy being pulled along by the drag in the water created by the ship. Probably the most amazing part was not only watching them but listening to them as well. Because they were so close, just about 12 feet below me as I stood on the deck of the ship, I could hear their clicks and high-pitched whistles. Watching their fun dance in the water, I noticed that many of the dolphins would swim for a few seconds together, belly to belly. Then they would speed off and find a new dance partner; I thought it was very sweet and adorable. It took me a minute to figure it out, but then I realized that they were doing a little more than just "dancing" together. Oh....They were truly enjoying themselves!

Personal Log

I didn't realize how long it had been since I had watched the sun set. Not just the casual, driving in your car and you notice the daylight fade, but when you sit down with the intention of taking in a real sunset. When you watch from the first signs of an orange sky until the last smidge of brilliant red slips gently down over the horizon. I had the chance to watch one of those sunsets today, start to finish. It reminded me of summers out at the Shoals Marine Lab when we would actually stop teaching class just to sit out on the porch and admire something that happens every day, but is nevertheless spectacular. I am always surprised how quickly it happens. All day long, it is impossible to notice our movement relative to the sun, but it only takes a few minutes to transition from day to night. And the real highlight is not the exact moment that the sun disappears, but minutes after the sun has set, when the entire sky glows red. Tonight was the first moon that I have seen on the trip, and it was curved into a smile hanging in the sky. It grinned next to Venus on the pink backdrop, above the midnight water with a large tanker drifting by in the distance.

One of my favorite parts of this adventure so far is just being able to spend all day outside. I wake up in the morning—usually around 9:00 (I haven't slept in so late since before Madelyn was born—but it is because my night shift ends at

midnight—and maybe because the gentle rocking of the ship helps me sleep so fitfully!). I hurry to get dressed and then head right for the bow of the boat. There I search for dolphins and sunfish for about an hour or so before it is time to get ready for work. The past two days have been so beautiful, that I haven't wanted to be inside the boat at all during the day—for fear that I might miss something spectacular! Because of this, I haven't had the chance to do as much writing as I would like. I tried using the laptop outside—but the glare is too great. It just doesn't work! After a long and draining winter/spring, it feels so good to get recharged by the solar energy!

University of Delaware R/V *Hugh R. Sharp*

Mission: Sea Scallop Survey: Leg III

Port of Departure: Lewes, Delaware

Location: Off the coast of New Jersey

Date: May 18, 2010

Weather Data from the Bridge

Rainy and rough!

Science and Technology Log

This experience has felt very much like an episode of a Discovery Channel production. At times it is *Dirty Jobs*, others it is *The Deadliest Catch* and the best is when you see something so spectacular it is like a segment of *Planet Earth* or *Life*. Today is much more of a *Deadliest Catch* day. The seas are rough!!! Usually swells between 4-6 ft, and occasionally 12ft. This sends contents of cabinets sliding, computer keyboards fall off tables, and a repetitive banging that I can't quite figure out its origin. On the 01 deck (that's where our lounge is, the science lab and the galley are located) you can see the water splash the porthole windows. One second all you can see is foggy skies and the next water fills the entire view. Up on the bridge is the best place to observe the rough water, if you can see past the pouring rain. Because the bridge is so high off of the sea's surface, the ride is much rockier. The charcoal gray water sometimes looks like a pot filled with boiling water with lots of quick waves. Other times the waves are bigger and last longer. You can watch the waves crash over the bow and sometimes splash the windshield. There is a jar of peanuts on a long counter that just slides the length back and forth, back and forth. Because of the weather, we have suspended our search for scallops for a little while because it was too dangerous out on the back deck of the boat, where we do our sorting.

While I was up in the bridge this morning, watching the rumbling water, I thought I caught a glimpse of a whale surface and then take a breath. I had been waiting for days to see a whale without any sightings. Although the captain had mentioned that he occasionally sees whales, I had assumed that we were still a little too far south to see them. They were closer to home up in the Gulf of Maine feeding away. I mentioned that I possibly saw a whale to the crew member I was standing next to and then studied the spot where I thought I had seen it. I didn't see the whale again, but I did notice how the white caps and large waves looked very similar to whale and maybe I was mistaken. Just when I was starting to doubt myself, a crew member pointed and matter-of-factly said, "Whale." Sure enough, one whale surfaced and took a big gulp of water. Then another whale surfaced and another! Three whales! We were able watch them for a couple of minutes before they disappeared. The visibility was so poor, between the fogged up windshields, the rain and of course the tumbling waves that we couldn't see much of them or determine which species they were, but it was really exciting to see them out there!

In addition to the whales today, yesterday we also saw something else that was on my must-see list for my trip—sharks!!! Hundreds of them! It was an overcast and grey day, but the water was so smooth, like you could just ice skate across it. The color of the sea and sky and the smell of the ocean reminded me of Maine. I thought of the island hoping sea kayaking trips we used to take. The captain radioed down to us in the science lab that he saw a shark. I went outside to the back deck and looked of the starboard side of the boat. There I noticed a small, black triangle pop up and pierce the still surface. As I watched the water, more appeared. As I searched the water, everywhere I looked I saw these dorsal fins. Then Larry, called to me from the port side of the boat, "Julianne you have got to see all these sharks, I have never seen anything like it before." There on the other side of the boat, were just as many sharks—they were surrounding us! Because all we could see was their dorsal fins and sometimes their caudal fin, we are not sure what kind they were, something small, but loads of them! We had to speed off and leave them to sample at our next station, but it was an exciting encounter.

Another welcome site yesterday, after two days of not finding much in the way of scallops—we finally pulled up lots of them. In one dredge in particular there were over 3,000, filling baskets and baskets of them. After feeling a little discouraged about not finding many, I welcomed the task of measuring the lengths of hundreds of scallops!

Personal Log

Amy K wanted to know, “Is it hard to sleep on the boat?” It is wonderful sleeping on the boat. After the first day or two, after my stomach got used to the movements of the ship, I started to really enjoy being rocked to sleep. There are some curious noises that take some getting used to, however. Sometimes I wake up in the middle of the night thinking I am listening to my roommate in the bunk above me snore very loudly, but then I realize is the ship’s engine sighing deeply over and over again. And other times I wake up angry that someone is vacuuming on the deck (or maybe they are using a palm sander) above me—it takes me a minute to remember that I am on a boat. Finally, there must be a large water tank somewhere around our room, because there is a constant, glub, glub, glubing coming from somewhere. As comfortable as it is in bed, getting out of bed is a challenge! The first step out of bed is the hardest. It is really dark in the bunkrooms because they are in the ship’s hull and don’t have any windows. It’s the kind of dark where you aren’t sure if you eyes are open or closed. This is very convenient for sleeping in after a late night counting scallops. And you don’t want to turn the lights on because you don’t want to risk waking up your roommate. I have to use caution when I sit up, so my head doesn’t whack the bunk above me (still haven’t gotten the hang of that!) Once I’m seated I feel for my flip flops in the dark and slide them on. Then comes the challenging part, trying to stand up on the rocking ship. I get myself upright and then take a tentative step towards the door. Just when I think I am about to firmly plant my foot the floor falls out from beneath me as the boat teeters back and forth. This sends me lurching towards the door where I reach out for the metal handle. With that as an anchor, I can then pull myself up and out, sneaking through a narrow opening in the doorway as I try to limit the amount of light that slips into the room. After those first couple of steps, then I am good to go!

While we ride out the weather, there isn’t too much to do but wait. I already finished reading one book, North to the Night by Alvah Simon, about a husband and wife who sailed their boat to the Arctic and intentionally let their boat get trapped in the sea ice so they could spend a year up North to learn about the Arctic people and wildlife. While the story of their odyssey is a little extreme it was fun to read about another sea adventure while I was on my own. But it is a little hard to read and work on the computer when the ride is so rough. It does make my stomach turn a little bit. To feel better, there are lots of pretzels and saltines to munch on.

So let me look at the things I wanted to see and learn about on this trip:

- ✓ To experience life at sea and that of a marine scientist
- ✓ To not see any land on the horizon
- ✓ To be the only boat on the water
- ✓ To learn about how fisheries are managed
- ✓ To be part of field data collection
- ✓ To learn about scallops
- ✓ To see shark s
- ✓ To see an ocean sunfish
- ✓ To see whales
- ✓ To see dolphins
- ✓ To have some beautiful weather
- ✓ To experience stormy weather

It looks like the trip so far has been a success! I can check all of those things off! We only have a couple of days left and each day seems to present something new to discover. I wonder what is left to see that I forgot to include on my list...

Log 6

University of Delaware R/V *Hugh R. Sharp*

Mission: Sea Scallop Survey: Leg III

Port of Departure: Lewes, Delaware

Location: Off the coast of New Jersey

Date: May 20, 2010

Weather Data from the Bridge

Clear skies, Air temp 14.55, Humidity 84%, Seas 2-3 ft

Science and Technology Log

What a difference a day makes! Today was a beautiful day! The sun was out and the ocean was settled again. It was so clear and flat that it was a perfect day for whale watching! I saw a bunch of whales, a couple of fin whales, but also a humpback. The humpback was quite a ways off in the distance, but was definitely the whale that provided the most entertainment. When I looked off to the horizon I could see plumes of white water, but couldn't discern much more than that. I happened to be up in the bridge and asked the captain if could borrow the powerful binoculars to check it out. Upon closer inspection, the upheaval in the water was created by a humpback, splashing his fins. He rolled around lazily and then would slap his pectoral fins sending up the big waves of water that had caught my attention. He would float on his back for a minute, showing off the white undersides of his flippers and then slowly tip over, his fins going every which way. It was really spectacular. Then just before a deep dive, he raised his fluke up high in the water before sounding. It was majestic. He didn't surface again and we had a dredge being pulled up so I had to leave my watch. About 10 minutes later, out on the back deck everyone had gathered looking off the starboard side of the boat. The whale was back and much closer; I was even able to grab a photograph as he continued his antics. When discussing the event with the captain, even though she has seen hundreds of whales, she still says, "That it (watching whales) never gets old."

We are finishing up our data collection with only a few more stations to go. When thinking about the trip and what I have learned, one of the things that has made the biggest impression on me is how well-rounded the scientists are. Many of them have backgrounds in marine biology, but that is only the beginning of their expertise. Sure, they can give you the scientific names of all the organisms that come up in the dredges and fun facts about each of them, but that seems like the easy part of their job. To do what they do so well, they have to wear many hats. They are at times engineers, designing and maintaining equipment to collect their data. This includes tasks like standing on the table on the moving deck of the ship, repairing the dredge. Or it could mean creating an apparatus to record video images of the dredge to monitor how effectively it is fishing. Their computer skills are remarkable; in the ship's science lab alone are six different computers each with a different purpose. There are various programs for charting our location, downloading the scallop data, and recording the readings from the inclinometer. Each of these programs requires a different skill set to interact with the information. Then you also need to know about ship operations. This includes being able to make decision about the weather and how it might impact the data collection. And this is all just to collect the data in the first place; this doesn't even include the actual analysis of the data. It is hard to imagine being skilled in all of these different facets of the job and has definitely broadened my idea of what a marine biologist does on a daily basis. The chief scientist had some good advice for those interested in a career in marine biology. His recommendation was for students to not go for a marine biology major but instead something more interdisciplinary. He feels as though a lot of the marine biology aspects of his job he learns very quickly in the field or from books. He recommends a curriculum that would include a study of oceanography, math/statistics and computers—those are the essential skills you need to be a good marine biologist.

Personal Log

I have read many scientific papers on the state of the world's fisheries and how many of collapsed or are on the verge of collapse. During this experience I learned about how fisheries are managed and what is being done to conserve these resources. I never suspected the extent of the data collection that goes into make decisions about fisheries. We collected data at over 190 stations, representing thousands and thousands of scallops. And we are only the first leg of this mission; there are two other legs to go. To think that this much research goes into monitoring scallops and then

that there are other surveys that take place for other commercially important species. I now realize the scope of how important this information is; decisions will be made using this data about where/when people can fish for scallops. For this reason, it is essential that the data is accurate. I learned about all the checks and balances in place for collecting data and how important it is to standardize procedures. I think that I will be able to bring that new perspective to my classroom. When we discuss ocean species that are in danger, I feel like I will be able to better explain how scientists have collected that data and how we know it is reliable. In addition, I have a lot more advice to share with students who are interested in the marine sciences.

I love my job as a teacher, but I have often wondered if maybe if I would like to have a more active part in the scientific learning about the ocean and its inhabitants. This experience allowed me the best of both worlds. I feel like in some small way I got to contribute to the sustainability of one of our most important fisheries. But also I got the opportunity to see what it feels like to collect that data and have conversations about the data. As teachers we communicate and share lots of information with our students, but because I had the opportunity to be a part of an authentic research project I will now have a much better understanding of where that information comes from. What I think would be a very cool next step, would be develop a project where my students get to help with the data collection.

It is a beautiful clear night with a bright half moon. There are lots of boats off in the distance. When I look quickly out onto the water, the lights from the boats and the stars above blur together, it is hard to tell where one end and the other begins. Probably the highlight of the trip for me was the opportunity to live aboard a research vessel—I loved my time on the water. Every time I stopped for a minute to stare at the water, I discovered something; whether it was the breath of a whale, a shark's fin or a jellyfish passing by.